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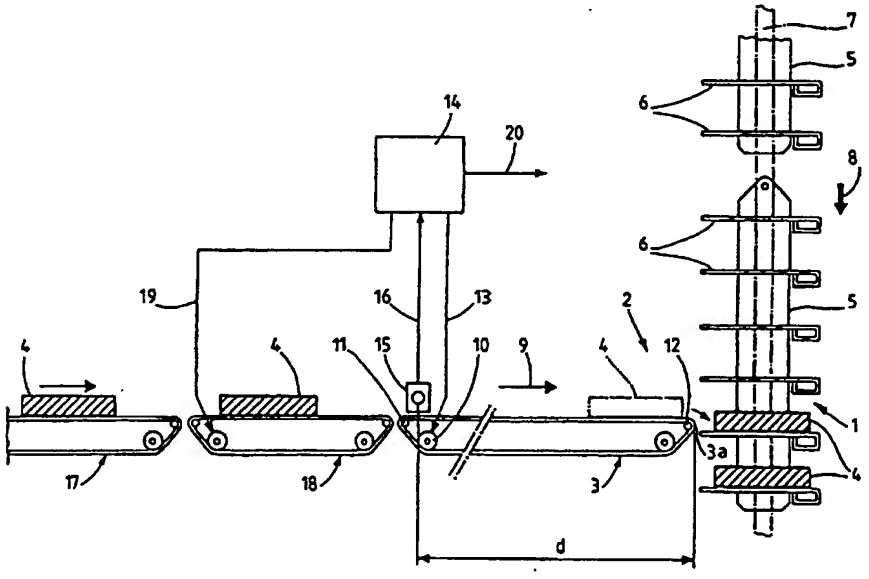
(54) Abstract Title
Chain store and method for loading thereof

(57) A chain store, of the type having a loading belt 1 including a plurality of intermittently movable pods 5 which serve for holding articles 4 to be stored and which pods are suspended from at least one articulated chain 7, usable for the intermediate accumulation of, for example, food packs such as chocolate bars, comprises a loading station 2 by means of which the speed of the loading belt 1 is controlled as a function of the frequency of the arriving articles 4. For this purpose, the loading station 2 has a horizontal conveyor belt 3 leading to the loading belt 1 and, at a specific distance d before the ejection edge 3a of the conveyor belt 3, a light barrier 15 is arranged above the belt 3. During the operation of the loading station 2, the arrival time of each article 4 arriving at the conveyor belt 3 is registered by the light barrier 15, and a measured variable which is a measure of the arrival time of the article 4 at the ejection edge 3a is determined from this arrival time, from the speed of the conveyor belt 3 and from the distance d. From this measured variable, the speed of the loading belt 1 can then finally be optimally regulated and controlled for each individual article 4 to be loaded.



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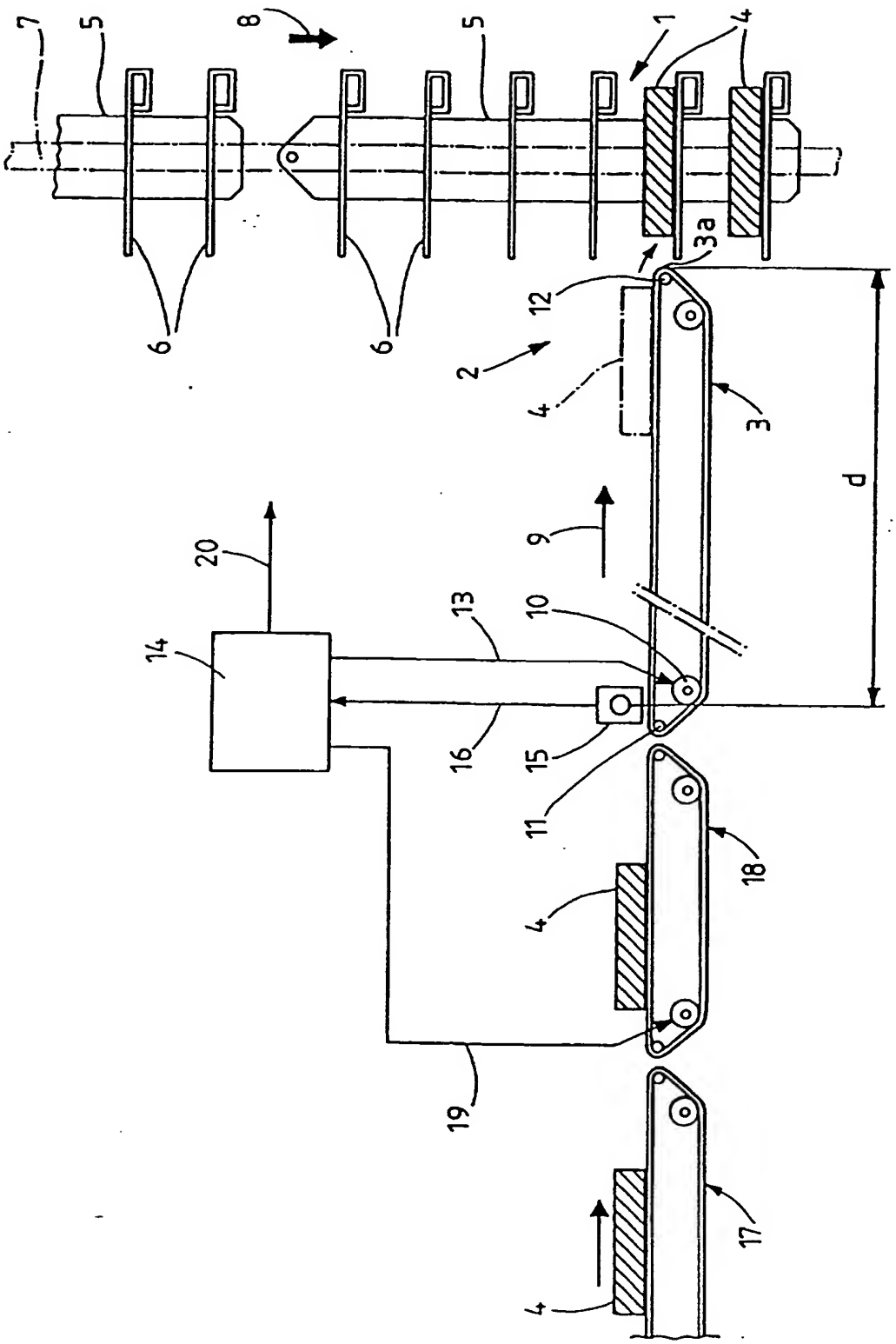
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Chain store and method for loading it

The invention relates to a chain store and a method for loading the chain store, namely a chain store according to the precharacterizing clause of Claim 1 and a method according to the precharacterizing clause of Claim 4.

The chain store and the method can be used, for example, for intermediate storage of food packs, for example for storing chocolate bars.

Chain stores are conveyors which are integrated in an overall production line used for manufacturing a product and serve for buffering and/or briefly storing the transported material. Chain stores can be arranged, for example, between two processing apparatuses handling the conveyed material, in order to maintain the operation of the overall production line, at least for a certain time, in the event of a temporary failure of a processing apparatus.

However, chain stores can also be used for storing and further conveying articles of the same type which arrive at irregular intervals, so that they can be transported on afterwards with constant spacing to a conveyor belt connecting with the chain store.

In known chain stores for intermediate storage of articles on shelves suspended from two chains, the chains of the loading and unloading belt which are each driven by a drive motor are moved intermittently, that is to say they are stationary while articles are loaded onto the shelves at the loading station and are unloaded from the shelves at the unloading station.

In order, for example, to stop the shelves at the height of a moving conveyor belt during the loading process, known, automatically operating chain stores have an

electronically and/or electrically controllable regulating device.

When a first shelf reaches the loading station in a chain store having an automatically operating loading station, the regulating device switches off the drive motor of the chain store, or uncouples the drive drum from the gear, in such a way that the shelf remains stationary at the height of the incoming conveyor belt. The articles are then transferred by the onward-moving conveyor belt to the shelf which stands ready. As soon as this transfer process is complete, the regulating device switches on the movement of the chains again so that the next shelf reaches the loading station and the process described above can be repeated.

These known chain stores have the disadvantage that the corresponding chain drive devices must be switched off for each loading process, with the result that not only is the effective transport speed of the loading belt of the chain store reduced but also disadvantageous rocking movements occur for those shelves whose suspension devices run over a deflection roller, which impairs the operational safety and reduces the life of the chain drive device.

A further problem which arises in the case of known chain stores is that the production rate in the various manufacturing operations is constantly increasing so that it is therefore necessary to increase the holding capacity of the chain stores, which finally is very often critical or even unfeasible in the case of the intermittent movement of the loading belt, which movement is described above.

It is the object of the invention to provide a chain store which has a novel loading station and does not have the disadvantages of the known chain stores. The loading station should in particular make it possible to load the articles relatively rapidly and in a shorter time onto the shelves of the store.

This object is achieved by a chain store having the features of Claim 1 and a method for loading the chain store having the features of Claim 4.

Advantageous embodiments of the chain store and of the method are evident from the dependent Claims.

An embodiment of the invention is described below with reference to the drawing.

The single Figure of the drawing shows a loading belt 1 of a chain store and an associated loading station 2, which in turn has a horizontal conveyor belt 3 as an essential element.

The chain store is formed, for example, as described in detail in DE-G 90 12 074.4. In the present case, it has in particular a multiplicity of pods which in turn are provided with a plurality of shelves 6, for example six, for receiving the articles 4 and are suspended from two chains 7 running vertically over a plurality of deflection rollers.

As evident from the Figure, the ejection edge 3a of the conveyor belt 3 is located close to the shelves 6 and pods 5 moving downwards in the direction of the arrow 8. During operation of the loading apparatus 2, the conveyor belt 3 is driven by a motor which is not shown, in such a way that said conveyor belt revolves in the direction of the arrow 9, i.e. from the drive wheel 10 via a deflection roller 11 to a further deflection roller 12 forming the ejection edge 3a and from said deflection roller 12 back to the drive wheel 10. The motor driving the drive wheel 10 is additionally connected via an electrical control line 13 to a central control unit 14 described in more detail below.

At that end of the conveyor belt 3 which is on the left in the drawing, i.e. at the deflection roller 11, a light barrier 15 which is likewise connected via an electrical line 16 to the central control unit 14 is mounted a fixed distance d from the ejection edge 3a.

The unit furthermore has two conveyor belts which are denoted by 17 and 18 and are arranged upstream of the belt 3 in the transport direction. Of these conveyor belts, the conveyor 17 serves for feeding the articles 4 to the loading station according to the invention. In contrast, the purpose of the belt 18 in the present invention is to accelerate temporarily and briefly articles in close succession and arranged in a row, so as to position them a distance apart such that they can be received by the chain store without switching off the conveyor belt 3 and without the action of additional mechanical means, such as, for example, of impact rods, displaceable transversely to the conveying movement, for separating articles arranged in a row.

The central control unit 14 includes a control circuit which is not shown and which comprises electrical and/or electronic components for control and regulation. The control circuit is moreover connected to the drive motor of the conveyor belt 18 and to the motor of the loading belt 1, in each case by an electrical connection indicated by the arrows 19 and 20, respectively. The control circuit furthermore has computing and control means for registering the signals measured by the light barrier 15 and for controlling the subsequent loading process in a manner yet to be explained in detail and dependent on these signals or on a measured value determined therefrom. For this purpose, the control circuit may have, for example, analogue operational amplifiers, comparator circuits and the like and/or an analogue/digital converter for converting the measured signals into digital signals and a digital computer.

The central control unit 14 furthermore has analogue and/or digital display means which serve for displaying operating states and the like. Said means may be formed, for example, for continuously displaying the free

loading capacity of the chain store during the operation of the loading station 2.

Furthermore, manually operable controls are present, by means of which, for example, the speed of the loading belt 1, the transport speed of the belt 18 or even the speed of the conveyor belt 3 may be regulated manually, preferably steplessly.

The control unit 14 is thus formed in such a way that the sequence of the process described below for loading the chain store can be controlled either by manual operation of controls at least partly by a person or completely automatically.

It is intended to control the loading process described below as far as possible continuously automatically and to control the method "manually" by a person only temporarily. The latter is necessary, for example, when the incoming articles follow one another so closely that they can no longer be separated sufficiently for trouble-free loading, so that in this case both the movement of the loading belt 1 and the conveyor belt 3 must be switched off. In such a case, after elimination of the back-up, the chain store and its loading mechanism must be readjusted for resuming operation. This adjustment is preferably carried out manually.

The apparatus described above operates in the automatic mode as follows:

From the conveyor belts 17 and 18 serving as feed belts, the individual articles 4 arrive at regular or irregular intervals at the conveyor belt 3, which is preferably driven at constant speed during the loading process.

If an article 4 reaches the region of the light barrier 15, a signal is sent to the control unit 14, after which the latter determines the time of arrival of the article 4 at the ejection edge 3a from the speed of the conveyor belt 3 and the distance d. From this measured

variable and the ejection time dependent on the dimensions of the article and on the speed of the conveyor belt 3 (= time which the article 4 requires, after arriving at the ejection edge 3a, to be transferred to a shelf 6 below the belt height), the control unit 14 now regulates the speed of the loading belt 1 moving downwards in the direction of the arrow 8, so that the article 4 arriving at the ejection edge 3a can be received by a shelf 6 without it being necessary to switch off the loading belt 1. This speed adjustment of the loading belt 1 is then redetermined for each further article 4 arriving at the conveyor belt 3.

During normal operation, the articles 4 reach the conveyor belt 3 at virtually constant intervals, so that the loading belt 1 can be moved with only slight speed corrections during the loading of a pod 5. During normal operation, the loading belt 1 must therefore be briefly accelerated only for pod change, that is to say for the jump from one pod to the next, since in this case the distance between the two successive shelves 6 is substantially greater than the shelf height within a pod 5.

If, during loading of a pod 5, the articles 4 arrive at the conveyor belt 3 with larger and optionally even irregular spacings and accordingly reach the region of the light barrier 15 at larger time intervals, the speed of the loading belt 1 is decreased so that the next shelf 6 to be loaded is moved past the ejection edge 3a when the article 4 to be loaded arrives at said edge, after which said article can be received by the shelf 6 without being jammed, or the drive motor of the loading belt 1 is switched off, or the drive drum is uncoupled from the gear, in such a way that the shelf 6 remains stationary above the conveyor belt 7. In the latter case, the chain drive of the loading belt 1 is put into operation again as soon as the article 4 to be loaded onto this shelf 6 passes the light barrier 15, this likewise being effected in such a way that the shelf 6 moves past the

ejection edge 3a and is provided for loading no later than when the article 4 to be loaded arrives at the ejection edge 3a.

If however, for loading a pod 5, the articles 4 arrive at the conveyor belt 3 at shorter intervals and accordingly reach the region of the light barrier 15 within shorter time intervals, the speed of the loading belt 1 is increased. This increase, too, is determined from said measured variable and the time interval between two successive articles 4, and, analogously to the above statements, the shelf 6 to be loaded is moved past the ejection edge 3a and is provided for loading no later than when the article 4 to be loaded arrives at the ejection edge 3a.

In this particular case, when adjusting the speed of the loading belt 1 it should be ensured that the article 4 to be loaded is not touched and jammed by the subsequent shelf during the transfer from the ejection edge 3a to the shelf 6. A maximum speed of the loading belt 1 which is dependent on the shelf height, on the size or length of the article 4 and on the speed of the conveyor belt 3 therefore may not be exceeded.

To avoid approaching this maximum speed, the invention envisages avoiding the arrival of articles too close together one behind the other on the conveyor belt 3 by separating such articles before they reach the belt 3. This can be effected, on the one hand, by upstream means, such as, for example, by impact rods displaceable transversely to the conveying movement or by a brief acceleration of the arriving articles before being placed on the conveyor belt 3. As already mentioned, the latter is permitted by the upstream acceleration belt 18, whose drive speed can likewise be regulated by the central control unit 14. For the purposes of the invention, this regulation, too, is preferably effected automatically, so that at least one further light

barrier arranged in the region of the conveyor belt 17 is arranged for this purpose in order to register any row of articles which may be forming or has already formed.

At this point, it should also be pointed out that the chain store described above and also the loading method which can be carried out with its loading station represent only one choice from a plurality of possible embodiments of the invention and can be modified in various respects.

Thus, for example, the loading belt can also be moved from bottom to top so that the above loading method is then correspondingly adapted.

The speed of the conveyor belt 3 is constant during the loading process, which permits relatively simple electronic controls. For the purposes of the invention, it is however also possible, with the use of correspondingly formed electronic control means, to regulate the speed of the conveyor belt 3 as a function of the distance between the successive articles in such a way that the loading capacity of the chain store can thus be further increased.

CLAIMS

1. Chain store having

- a plurality of intermittently movable pods (5) which serve for holding articles (4) to be stored and are suspended from at least one articulated chain (7) running vertically over a plurality of deflection rollers, and
- a loading station which is arranged on an upward- or downward-moving belt of a chain store and has at least one horizontal conveyor belt (3) leading to the loading belt (1),

characterized in that a measuring member (15) which is arranged above the belt (3) and registers the arrival time of each arriving article (4) at a distance d before the loading belt (1) is provided at a specific distance d before the ejection edge (3a) of the conveyor belt (3), and that a control unit (14) connected to the measuring member (15) and to the drive device of the loading belt (1) is present in order to determine, from the arrival time registered by the measuring member (15), from the speed of the conveyor belt (3) and from the distance d, a measured variable which is a measure of the arrival time of the article (4) at the ejection edge (3a), and from this to control the speed of the loading belt (1) as a function of the frequency of the arriving articles (4).

2. Apparatus according to Claim 1, characterized in that said measuring member (15) is a light barrier.

3. Apparatus according to Claim 1 or 2, characterized in that an accelerating belt (18) is arranged before the horizontal conveyor belt (3), in order briefly to accelerate articles (4) following closely in succession and then to transfer said articles to the conveyor belt (3) so that the distance between the articles (4) arranged in a row is thus increased.

4. Method for loading a chain store which has a loading station (2) which is arranged on the outer upward- or downward-moving belt and has a horizontal conveyor belt (3) leading to the loading belt and a plurality of intermittently movable pods (5) which serve for receiving articles (4) and in turn are suspended from at least one articulated chain (7) running vertically over a plurality of deflection rollers, characterized in that the arrival time of each article (4) arriving at the conveyor belt (3) is determined at a specific distance d from the ejection edge (3a) of the conveyor belt (3), that a measured quantity which is a measure of the arrival time of the article (4) at the ejection edge (3a) is to be determined from this arrival time, from the speed of the conveyor belt (3) and from the distance d, and that from this the speed of the loading belt (1) is controlled as a function of the frequency of the arriving articles (4).

5. Method according to Claim 4, characterized in that the conveyor belt (3) is driven at constant speed during the loading process.

6. Method as claimed in claim 1 and substantially as hereinbefore described with reference to the accompanying drawing.

The Patent Office

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Application No: GB 9907702.6 **Examiner:** Paul Makin
Claims searched: 1-6 **Date of search:** 3 June 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B8A (ACF)

Int Cl (Ed.6): B65G 47/51

Other: Online : WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2124574 A	(CKD CORPORATION) see particularly line 89, page 2 - line 11 page 3.	1,2,4,5

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.